Claims

1. Plastic structural element comprising a plastic material and one or more inserts having a length embedded in the plastic material, such that the inserts exhibit the same or different values of rigidity and/or thermal expansion coefficients compared to those of the plastic.

   characterised in that,

   the plastic structural element (56) exhibits at least one of the following features:

   a) the insert (8) is joined to the plastic material (6) via a coupling layer (7) of plastic, and the coupling layer (7) produces a gradual or uniform equilibration of the E-modulus determining the stiffness and/or the coefficient of thermal expansion between the plastic material (6) and the insert (8) and/or

   b) the embedded length (69) of insert features one or more openings (62) through which reinforcing fibres, fibre strands and/or textile type materials (61) are looped and are embedded in and intimately joined to the plastic matrix of the plastic structural element and/or

   c) the embedded length (30) of insert (18) feature strips or fingers or finger-shaped projections that lie parallel or are comb-like or fan-shape in their arrangement

   whereby the composite exhibits improved strength and durability between the plastic material (6) and the insert (8) and withstands higher loads.

2. Plastic structural element according to claim 1, characterised in that the coupling layer (7) contains a reinforced plastic in an epoxy resin matrix, in particular a fibre-reinforced plastic, preferably a GRP, in particular E-glass fibres, or a CRP, in particular HT carbon fibres, or a mixture of CRP and GRP with a fibre content of 30 – 70 vol.%, preferably 45 – 60 vol.%.

3. Plastic structural element according to one of the claims 1 to 2, characterised in that the plastic material (6) contains a reinforced plastic in an epoxy resin matrix, in particular a fibre-reinforced plastic, preferably a GRP or CRP, in particular HM

carbon, or a mixture of GRP and CRP with a fibre content of 40 – 70 vol.%, preferably 55 – 65 vol.%.

4. Plastic structural element according to one of the claims 1 to 3, characterised in that the insert (8) contains a metal, in particular aluminium, magnesium or an alloy contain-ing at least aluminium or magnesium or steel or zinc coated iron.

5. Plastic structural element according to one of the claims 1 to 4, characterised in that the insert (8) is made of aluminium, magnesium or an alloy containing at least aluminium or magnesium, and the plastic material is reinforced by fibres, in particular carbon fibres and exhibits a fibre content of 40 vol.% to 70 vol.%, and the coupling layer is reinforced by fibres, in particular HT carbon fibres, or glass fibres, in particular E-type glass fibres or a mixture of carbon fibres and glass fibres, and the fibre content of the coupling layer (7) is on average 5 – 15 vol.% lower than in the plastic material (6).

6. Plastic structural element according to claim 2 and 5, characterised in that the volume fraction of fibres in the coupling layer (7), starting from the plastic material (6) gradually or uniformly decreases towards the insert (8), and/or the fraction of glass fibres increases towards the insert (8) in relation to the amount of carbon fibres.

7. Plastic structural element according to one of the claims 1 to 6, characterised in that the insert (13) is made of aluminium, magnesium or an alloy containing at least aluminium or magnesium, and the coupling layer (12) is a layer type composite and exhibits a layer type structure of fibre layers, whereby the fibres in the individual layers are oriented in one, two or more, preferably however in one direction and preferably in the direction parallel to the side face (35), and the fibres or fibre layers lying next to the insert (13) preferably exhibit an orientation of –30 ° to –70° or +30° to +70°, where 0° represents the direction of the main forces acting on the insert, and the fibres or fibre layers lying close to the plastic material (11) align themselves with the direct-ion of the neighbouring fibres or fibre layers in the plastic material (11), whereby the deviation in the orientation of the fibres is usefully less than 60°, preferably less than 45°.

8. Plastic structural element according to claim 2 and 7, characterised in that the fibres in the fibre-reinforced plastic of the coupling layer (2) are in the form of fibre layers, whereby a plurality of fibre layers form a fibre layer system, and the individual fibre

layers or the individual fibre layer systems made up of a sequence of fibre layers contain different kinds of fibres, whereby the kinds of fibres are preferably carbon fibres, in particular HT carbon fibres, and glass fibres, and at least one fibre layer of glass fibres lies against the embedded length of insert (33).

9. Plastic structural element according to one of the claims 1 to 8, characterised in that the insert (8), at least at its surface, is of aluminium or its alloys and at the places receiving the coupling layer is chemically treated preferably phosphate treated, chromate treated or anodically oxidised.

10. Plastic structural element according to one of the claims 1 to 9, characterised in that the metallic surfaces of the insert (8) are degreased or roughened at the places receiving the coupling layer (7)

11. Plastic structural element according to one of the claims 1 to 10, characterised in that the embedded length (30) of the insert (18) features strips or fingers or finger-like shapes lying parallel or comb-like or fan-like and/or the embedded length (30) of insert (18) exhibits enlargement of the surface area, preferably in the form of openings or grid-like structures.

12. Plastic structural element according to one of the claims 1 to 11, characterised in that the embedded length (31) of insert (8) features anchor-like elements, preferably hook-shaped, T-shaped or trapezium-shaped projections or is itself in the shape of an anchoring element, preferably in the form of bends in the embedded length (31) of the insert (8), or roughness patterns, preferably corrugations.

13. Plastic structural element according to one of the claims 1 to 12, characterised in that the insert (40) in particular at its embedded length is provided with force transferring reinforcing fibres (41) at its free ends, preferably with rovings of fibres, usefully aramide fibres, which are laminated into the plastic material and anchor the insert (40) in the plastic material, whereby the laminated-in reinforcing fibres (41) are joined to the insert (40) by means of a loop-type connection.

14. Plastic structural element according to one of the claims 1 to 13, characterised in that the end parts (22) of the insert (21) are tapered with a ratio of x:y of 1:30 to 1:10, where the ratio x:y represents the tangent of the acute angle α which is formed by a

line running parallel to the central axis z and the line joining the two end points P, R of the tapering.

15. Process for manufacturing plastic structural elements according to claim 1,

characterised in that,

the insert is of metal (3) and this, in the region to come into contact with the coupling layer (2), is subjected to a surface treatment which improves bonding, and is provided with a coupling layer (2) of fibre-reinforced plastic, and the insert (3) with the length to project out of the plastic structural element (55) introduced by virtue of shape in a cavity in the mould or pressing tool, and the plastic structural element (55) is shaped in a casting or pressing process and the embedded length of insert (33) bearing the coupling layer (2) is laminated into the plastic material (1) and forms with that a join by virtue of shape.

16. Process for manufacturing plastic structural elements according to claim 15, characterised in that the coupling layer (2) is a fibre-type composite, is manufactured in an injection moulding process or Sheet-Transfer-Moulding-Compound (SMC) pro-cess, in a Resin-Transfer-Moulding (RTM) process or in a Reinforced Reaction Injection Moulding (RRIM) process and mounted on the length (33) of insert.

17. Process for manufacturing plastic structural elements according to one of the claims 15 to 16, characterised in that the coupling layer (2) is a fibre-layer-type composite and is in a Resin-Transfer-Moulding (RTM) process or by manual lamination is mounted on the length (33) of insert.

18. Process for manufacturing plastic structural elements according to one of the claims 15 to 17, characterised in that the plastic structural element (55) is manufactured in an injection moulding process, Sheet-Transfer-Moulding-Compound (SMC) process, Resin-Transfer-Moulding (RTM) process or in a Reinforced Reaction Injection Moulding (RRIM) process.

19. Road and railway vehicles, aircraft, machines and structures having at least one plastic structural element (55) according to claim 1.

add A2 ADD B1